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Earth & Space Science PhDs, Class of 1999

This report summarizes the latest annual survey of recent Earth and space science PhDs conducted by the Statistical Research Center of the American Institute of Physics (AIP). This study documents employment patterns and demographic characteristics of recent PhDs. Highlights of the results include the following:

- While almost one-third of graduates are employed in a different subfield than that of their degree, more than 80% of Earth and space science PhDs secure initial employment in the geosciences.
- More than 80% of graduates found employment in less than six months. The unemployment rate for new PhDs in the geosciences is negligible and significantly below that of two years ago.
- Only 38% of 1999 graduates took postdoctoral appointments, compared to 50% of the PhD class of 1998.
- Minorities are poorly represented in the geosciences. Hispanic-Americans and African-Americans combined made up less than 2% of all PhDs over the past 26 years. Seventeen universities are responsible for awarding almost half of all geoscience PhDs earned by Hispanic-Americans and African-Americans.

AGU & AGI Survey of the PhD Class of 1999

Introduction

The American Geophysical Union (AGU) and the American Geological Institute (AGI) are actively involved in collecting information on the employment of recent PhDs in the Earth and space sciences. For the past four years, AGU and AGI have surveyed new recipients of PhDs to collect information on their efforts to find their first jobs, their employment settings, the activities in which they are involved, and their starting salaries.

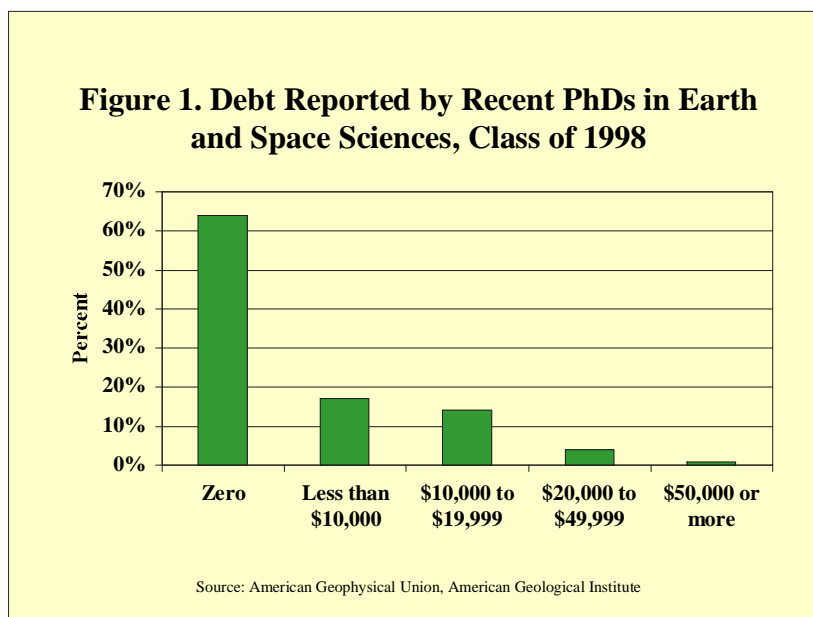
Each year letters are sent to Earth and space science departments requesting addresses of their recent graduates. The graduates are contacted directly and asked to fill out the survey. The data from 1996 and 1997 were collected as part of a larger multidisciplinary effort coordinated by the Commission on Professionals in Science and Technology (CPST). The AGU and AGI used the knowledge they gained from these first two studies and conducted surveys of the PhD classes of 1998 and 1999 using their own funds. The latter studies

included additional questions intended to provide a more complete picture of our graduates.

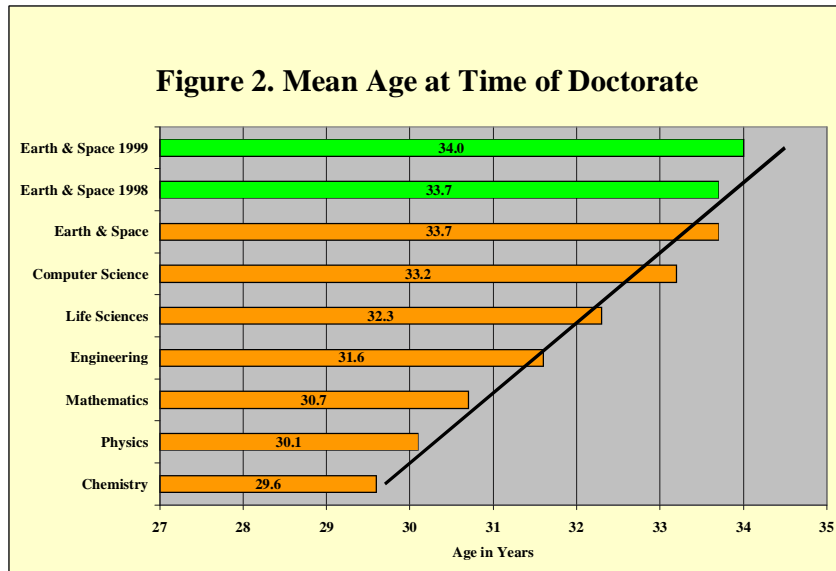
This report draws on the results of the surveys of the four PhD classes in the Earth and space sciences as well as data from the National Science Foundation (NSF). The results of the last four years have shown continual improvement in the job market as measured by such indicators as time to find employment and starting salaries. The results also show commensurate improvements in the opinions of recent graduates about both their employment opportunities and the qualitative aspects of their first positions after earning their degrees.

The respondents to our survey of Earth and space science departments included very few PhDs in space physics. This is because many of those individuals come out of physics departments. We have amended our data with those collected by the American Institute of Physics (AIP) to properly reflect the space sciences.

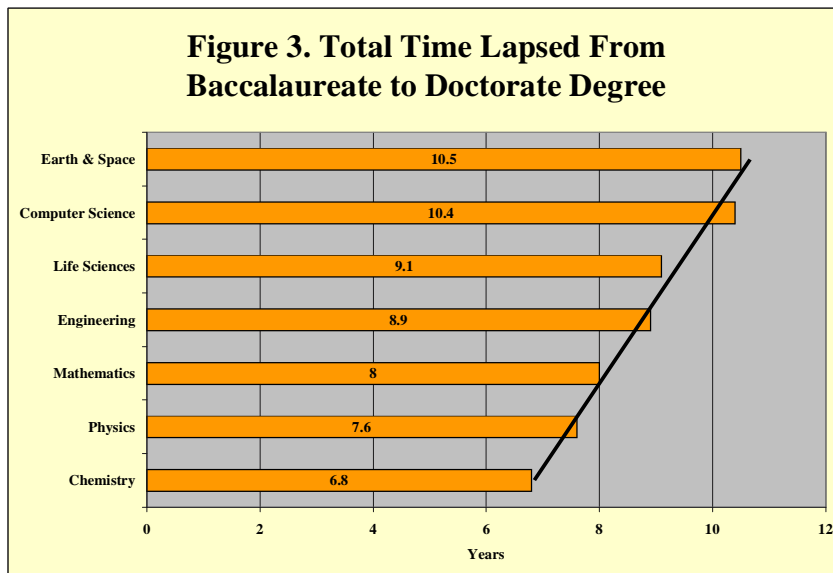
Highlights



The majority of recent Earth and space science PhDs accumulated no debt related to their education while in graduate school. Of those who did end graduate school in debt, the average they owed was modest. Nearly two-thirds had no debt and only 5% owed more than \$20,000.



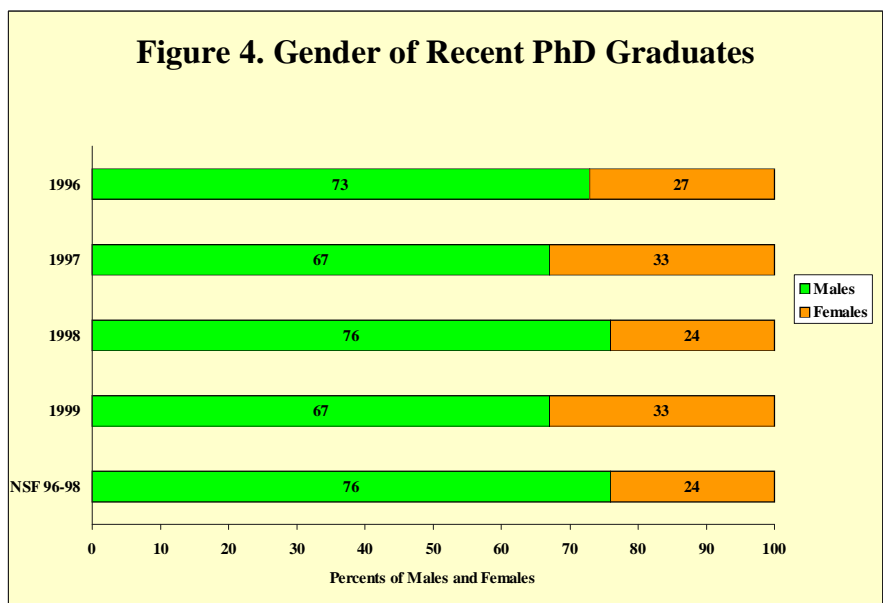
Source: National Science Foundation, 1998



Green bars indicate data collected in 1998 and 1999 through the AGI/AGU study; orange bars indicate data from the NSF.

PhDs in the Earth and space sciences are, as a group, older when they earn their doctorates than are PhDs in other physical sciences. Based on the 1998 NSF Survey of Earned Doctorates, we know that the Earth and space science candidates take longer to earn their degree than their colleagues in other sciences and have a higher average age at time of doctorate. In fact, a significant number of recent PhDs in our study (20%) are 40 or older when they earn their doctorates and a non-trivial number (9%) of recent PhDs had been working full-time for several years prior to earning their doctorates.

In light of these unique trends, we have conducted a follow-up study to explore this phenomenon. No dominant pattern has emerged. Some PhDs started graduate school years after completing their bachelor's; some took time off from their jobs to complete a PhD; others found a good job before completing their degree requirements and miscalculated how long it would take to finish their dissertation while working full-time.



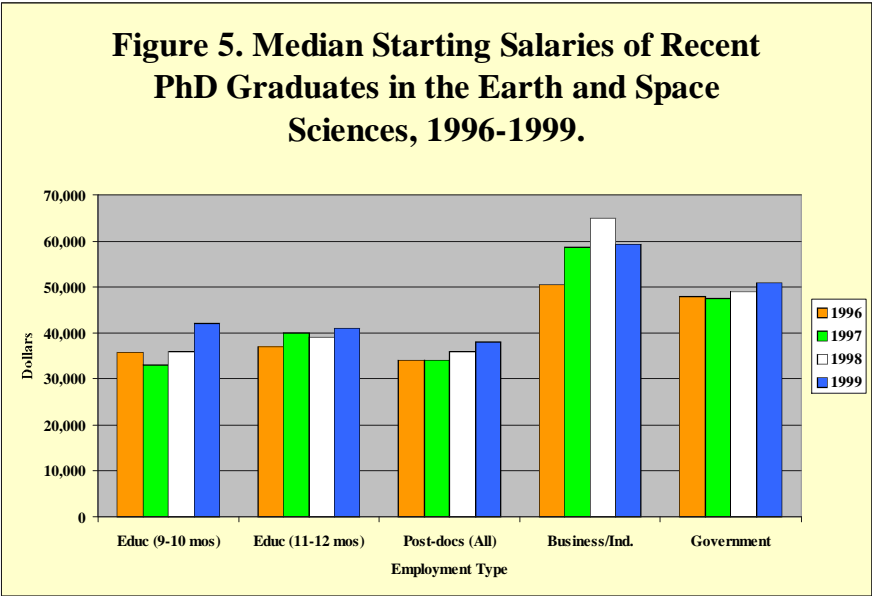
According to the NSF data from the Statistical Profile of Doctorate Recipients by Major Field, women have earned 24% of the PhDs in Earth and space sciences over the last 3 years (1996-1998). Our surveys have slightly higher numbers for women and this may be because women are responding to the studies at a somewhat higher rate.

Table 1. The universities that produced the highest number of minority PhDs in Earth and space sciences. These universities awarded nearly half of the PhDs earned by African-Americans and Hispanic-Americans from 1973 through 1998.

University of California - San Diego	Pennsylvania State University
University of Michigan - Ann Arbor	University of South Carolina - Columbia
Texas A&M University	University of Colorado - Boulder
University of California - Los Angeles	University of California - Santa Barbara
Stanford University	University of Miami
University of Arizona	Georgia Institute of Technology
University of California - Santa Cruz	University of Washington
University of Rhode Island	Columbia University
University of Texas - Dallas	

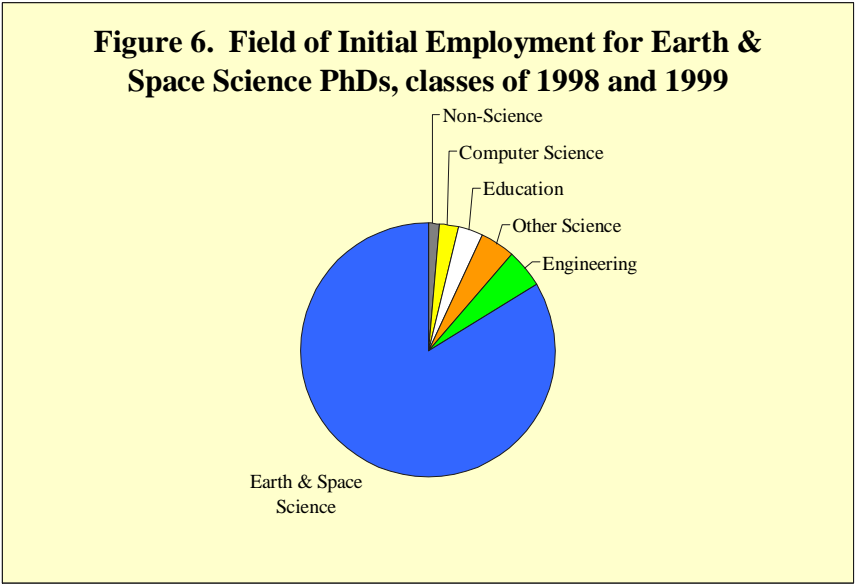
Source: AIP Statistical Research Center from data compiled by NSF

According to the NSF, 17,914 PhDs have been awarded in Earth and space sciences over the last 26 years (1973-1998). Of them, fewer than one-half of 1% (number=86) were earned by African Americans. Similarly, barely over 1% (number=224) were earned by Hispanic Americans. Of 183 universities with PhD-granting departments in the Earth and space sciences, only 53 have ever produced an African American PhD and 79 have ever produced an Hispanic PhD. The above table lists the universities that account for nearly half of the minority PhDs in the Earth and space sciences.



Note: The above data do not include those PhDs who were employed full-time for one or more years prior to earning their degree.

In general, the employment patterns for the PhDs of 1998 and 1999 were more positive than those of the preceding two PhD classes. Both classes had a lower unemployment rate and the median starting salaries appear solid, especially when disaggregated by type of position. In both of the last two years, median postdoc salaries have increased.



The vast majority (over 80%) of Earth and space science PhDs found work in the Earth and space sciences. Most of the PhDs who took postdoctoral positions work in their subfield of degree. Of those who found work outside of academe (industry, government and non-profit research institutes), most continue to work within the Earth and space sciences. Of the PhDs whose initial employment is outside of the Earth and space sciences, virtually all work within engineering, science or science education (see appendix, table A1).

Figure 7. Percentage of New PhDs Who Accepted Postdoctoral Appointments, 1996-1999.

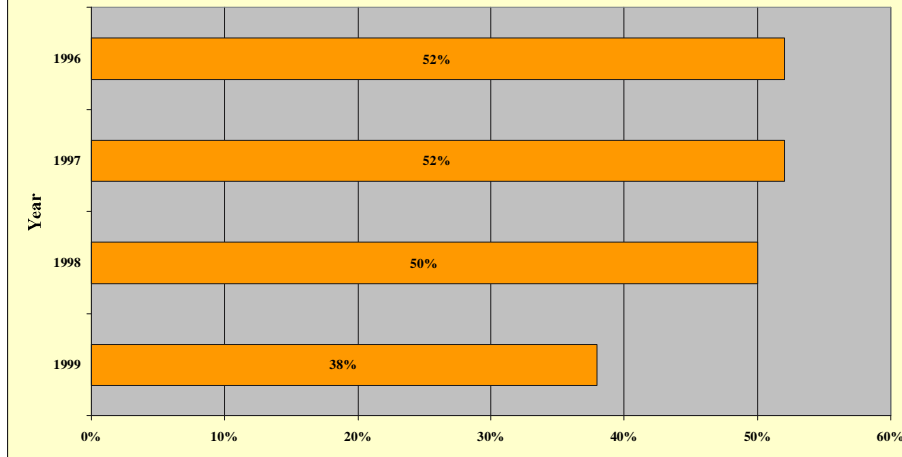


Table 2. Employment Sector by Postdoc Status and Year of Graduation.

	1996	1997	1998	1999
Postdocs	%	%	%	%
University	33	30	32	25
Government	6	6	11	12
Industry	2	1	-	-
Non-Profit	4	4	8	1
Non Postdocs				
Education	25	24	20	27
Government	10	9	8	17
Industry	17	24	20	16
Non-Profit	3	2	1	2

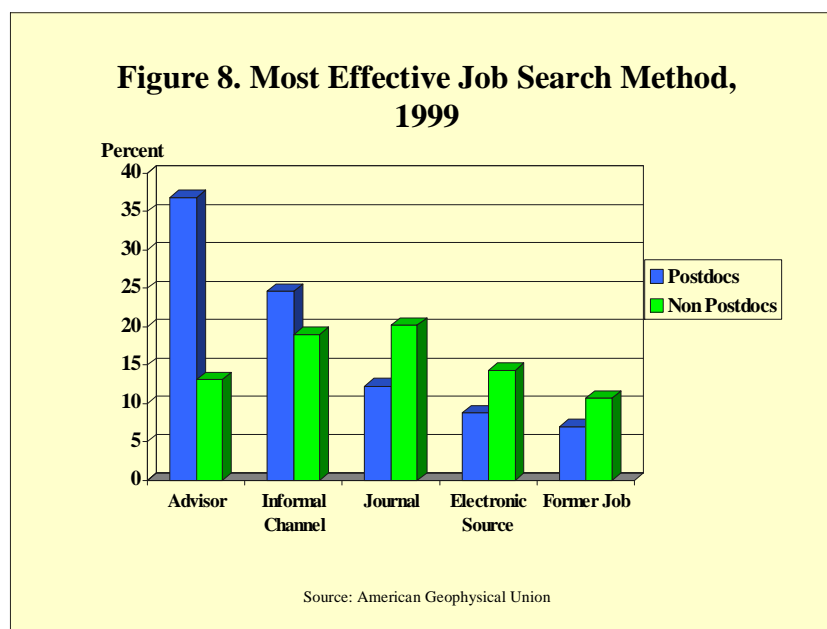
Note: A dash (-) indicates less than 1%

The class of 1999 showed a significant drop in the number of PhDs who took postdoctoral appointments - 38% in 1999 versus about half of each of the preceding three PhD classes. Postdoctoral appointments are defined as temporary positions in academe, industry, or government; they primarily provide continued training or education in research.

Conversely, there was an increase in the number of PhDs who found potentially permanent employment, especially in government and academe.

Table 3. Months spent looking for employment by postdoc status, 1999.			
	Postdoc %	Non-Postdoc %	Overall %
Zero months	14	24	20
1-2 months	36	25	29
4-6 months	37	31	33
More than 6 months	13	20	18
Total Number of Respondents	59	100	159

The 1999 Earth and space science PhDs who found positions reported that it took less time to find their jobs than the classes of 1996 and 1997 reported. However, in 1999 those PhDs who took non-postdoctoral positions in academe reported the longest average time to find employment. Several of these PhDs are in low-paying, temporary positions that they took when they could not secure better positions. Most, however, were apparently taking their time to find the right positions for them.

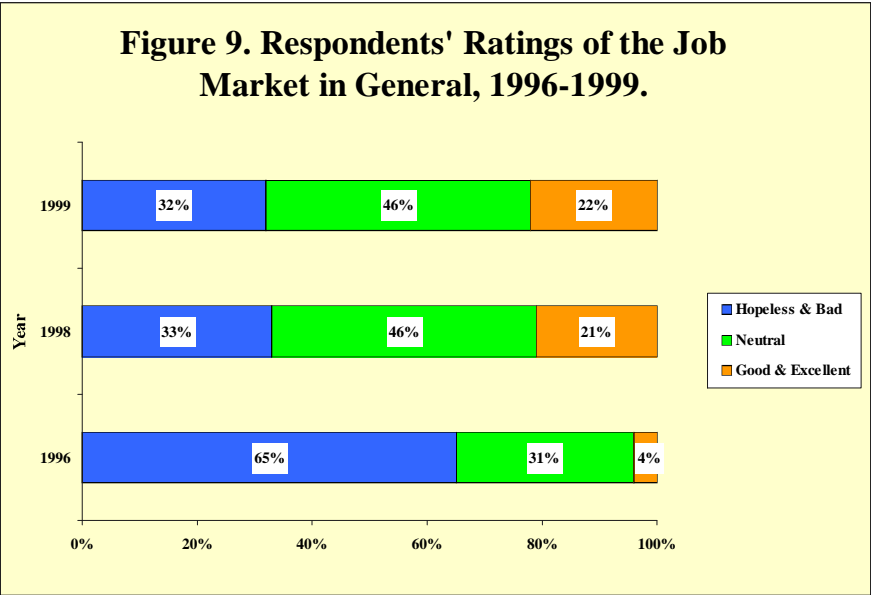


Earth and space science PhDs used virtually every available strategy in finding employment. Of those who took postdoctoral appointments, many noted that their advisors were very helpful. However, comparatively few, regardless of the position they secured, noted that they received assistance from their departments, institutions or professional societies (see appendix, Figure A1). Conversely, many noted that their employment search would have been strengthened with better information about where and how to look for employment, especially for positions beyond postdoctoral appointments (see appendix, Figure A2).

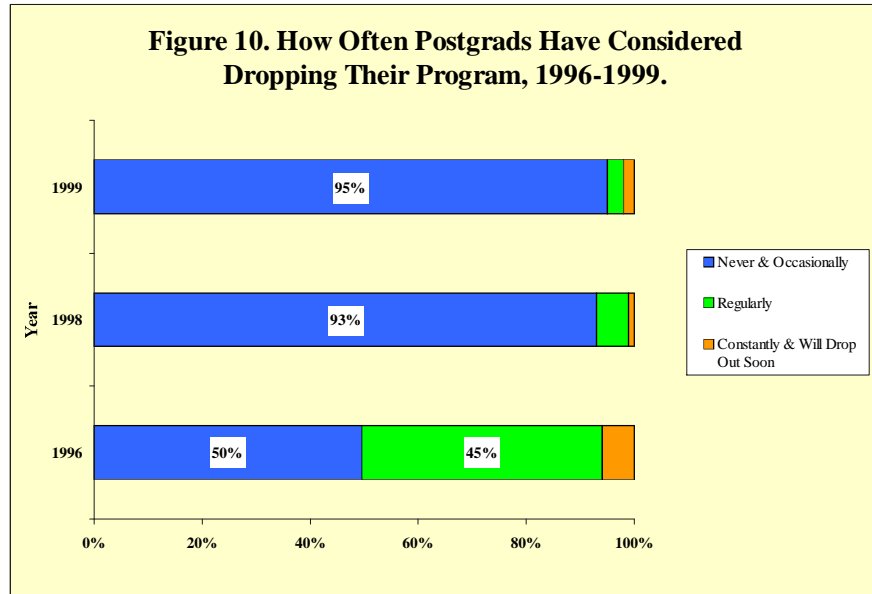
Table 4. PhDs' opinions about qualitative aspects of their current positions, 1999.			
	Agree %	Neutral %	Disagree %
My position is professionally challenging	81	12	7
My position is related to my field	80	10	10
My position is commensurate with my education	78	10	12
My position is similar to what I expected to be doing when I began my doctoral program	59	15	26
My position offers ample opportunity for advancement	46	23	31
My position offers ample job security	35	20	45

Respondents expressed their opinions using a 5-point scale with 1 being "strongly agree" and 5 being "strongly disagree". The data were collapsed with "agree" referring to respondents who chose 1 or 2 and "disagree" being respondents who chose 4 or 5.

In general, the data on the qualitative aspects of the initial employment of Earth and space science PhDs are quite positive. About 80% of respondents report that their first position is professionally challenging and that it is appropriate employment for an Earth and space science PhD. However, there are some weaknesses in the PhDs' perceptions of their current position. Even among those who are *not* in postdoctoral appointments, some of the respondents are concerned about their opportunities for advancement and their job security.



Approximately one-third of the respondents perceived the job market for Earth and space scientists as bad or hopeless. By contrast, fewer than one-quarter viewed it as good or excellent. While the level of these negative opinions are of considerable concern, they actually represent a significant improvement compared to those expressed four years ago. Fewer than 5% of the Earth and space science PhD class of 1996 perceived the job market as good or excellent after they earned their doctorates.



Most Earth and space science PhDs would pursue their degrees again if they had an opportunity to do it all over. However, many considered dropping out of graduate school for several dominant reasons including doubt about one’s ability and concern about career opportunities. It is essential that we determine whether these are accurate perceptions or are based on a lack of good information about career opportunities. In 1996, about half of the PhD recipients had considered dropping their graduate program regularly or constantly. By comparison, in 1999 this has dropped to less than 5%.

It should be noted that these data come from people who actually completed their degrees and do not include those who did, in fact, drop out. Thus, we believe that the large numbers of Earth and space science PhDs, who considered dropping out, point to possible courses of actions for both Earth and space science departments and for AGU/AGI. Unfortunately, we do not have comparable data from other disciplines because no other discipline has asked these questions.

Table 5. Top Reasons for Considering Dropping Out of PhD Program	
Reasons chosen by 20% or more:	
Poor job market	Didn’t feel intellectually capable
Poor relationship with advisor	Lost interest in subject matter
Financial concerns	Family concerns and responsibilities
Other reasons for dropping out:	
Loneliness and isolation	Poor working relationship with committee
Offered a job	Disliked the faculty in the department
Difficulty selecting dissertation topic	Disliked the students in the department
Note: This table is based on the 41% of respondents who indicated that they did consider dropping out of graduate school. Space Physics PhDs were not asked this question	

Appendix

Table A1. Percent change between PhD area and employment area, 1998 and 1999.

Subfield	Percent Change	Degree %	Employment %
Education	+5	-	5
Engineering	+4	-	4
Other Science	+4	-	4
Computer Science	+3	-	3
Other Geoscience	+2	5	7
Global Earth System Science and Remote Sensing	+2	2	4
Non-Science	+1	-	1
Public Policy	+1	-	1
Planetary Sciences	0	4	4
Geomagnetism and Paleomagnetism	0	1	1
Paleontology, Biogeochemistry	-1	4	3
Geodesy, Gravity, and Geodynamics	-1	1	-
Seismology	-1	6	5
Atmospheric Sciences and Meteorology	-1	16	15
Space Physics and Aeronomy	-1	4	3
Economic Geology and Exploration Geophysics	-2	7	5
Volcanology, Geochemistry, and Petrology	-2	8	6
Soil Sciences and Geomorphology	-3	7	4
Structural Geology, Tectonics, and Rock Mechanics	-3	6	3
Hydrology and Aqueous Geochemistry	-3	13	10
Ocean Sciences	-4	16	12

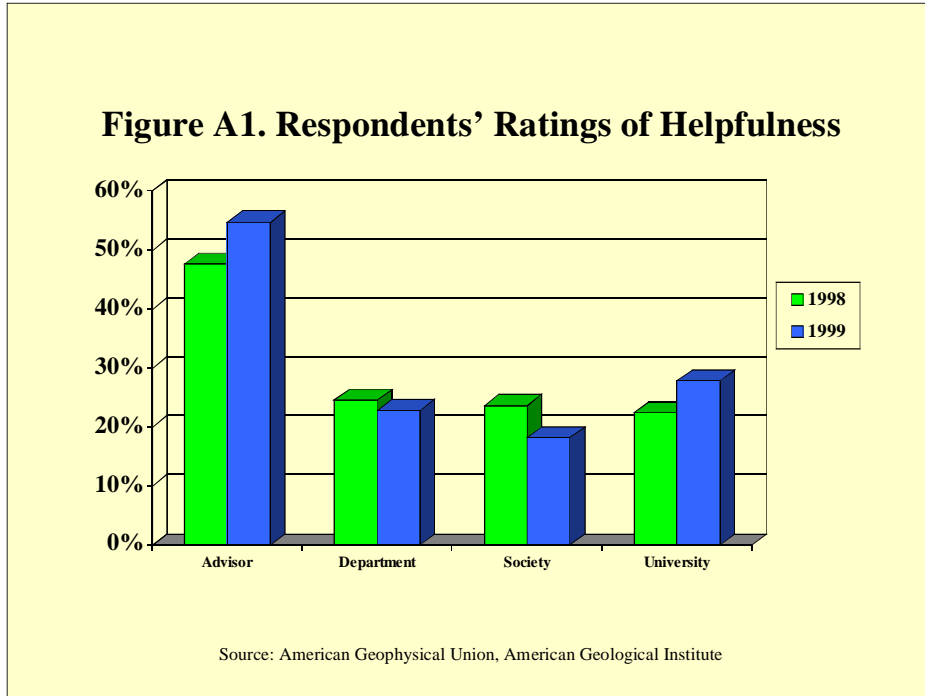
Note: Percent change indicates the change between the percent of respondents who earned their degrees from a particular subfield to the percent employed in that subfield. Positive change indicates that *more* people are employed in that subfield than earned degrees from that subfield. Negative change shows that *fewer* people are employed in that field than earned degrees in that field.

Methodology

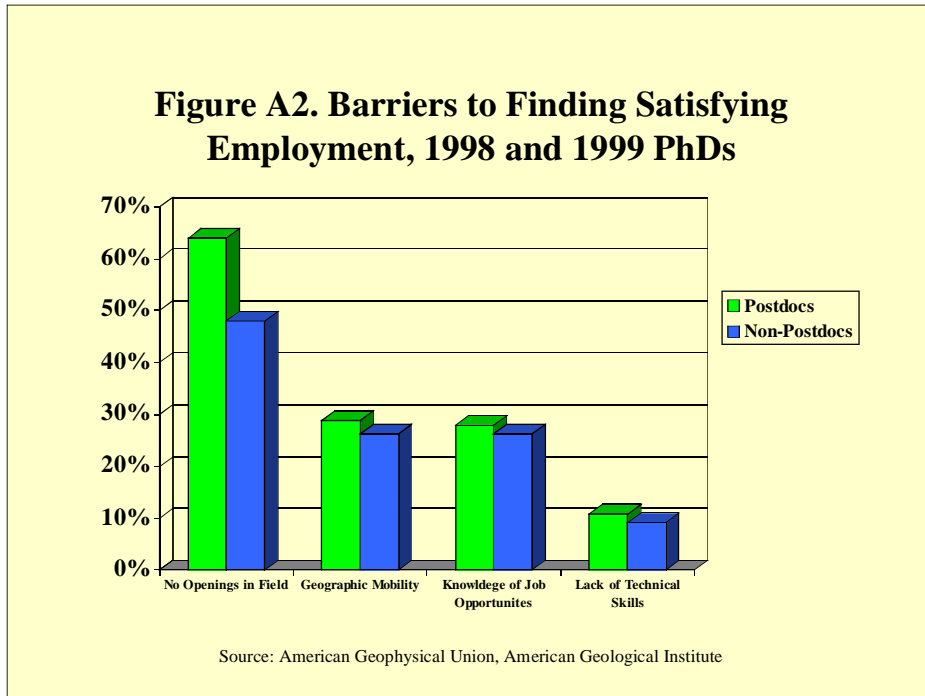
In March 2000, 249 PhD-granting Earth and space science Departments received a request for the names and addresses of their 1999 graduates. Those who did not respond received a second request in August and a third in September. By October, 176 departments replied, yielding a 71% response rate.

Questionnaires were sent to an initial list of 308 recent PhDs in July. Because we continued to receive information about new graduates from more departments, we sent weekly mailings from August to October. Of 410 PhDs surveyed, 175 responded for a response rate of 43%.

Appendix



Note: Respondents expressed their opinions using a 5-point scale with 1 being “strongly agree” and 5 being “strongly disagree”. The data were collasped with “agree” referring to respondents who chose 1 or 2 and disagree being respondents who chose 4 or 5. Data do not add to 100% because respondents expressed opinions on multiple items.



Note: Respondents were able to choose up to six barriers to satisfying employment. Above are the answers where more than 10% of those responding indicated that this was a barrier. These data do not include the 23 Space Physics PhDs who were not asked this question.

